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SOIL EROSION, RUN OFF AND NUTRIENT LOSS IN SELECTED WATERSHEDS OF KODAIKANAL HILLS

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ABSTRACT

An investigation was carried out during June, 1991 - May, 1992 at the Horticultural Research Station, Kodaikanal to study the effect of rainfall, stream flow and vegetation on soil erosion and run off. The natural forest *shola* enjoying different types of vegetational cover without any soil conservation measure was compared with cultivated banana watershed having contour stone wall as soil conservation measure. The sediment lost through soil erosion and run off and the nutrient lost from the surface soils of the above watersheds were quantified at monthly intervals. The results revealed that the monthly average rainfall more or less ramained the same in both the watersheds with the highest rainfall during October. The data on sediment loss indicated that the forest *shola* watershed had a higher rate (600 kg/ha/year) of soil erosion than the banana watershed (504 kg/ha/year). The cumulative water lost through run off was higher (121 mm) in *shola* than the banana watershed (91 mm). The sedimentation and run off reached their peak in the month of October in both the watersheds. The loss of major nutrients also followed a similar pattern as that of the run off water but the levels of loss of N and K were relatively higher than that of P. The differential soil and nutrient loss through run off water was attributed to the initial soil properties, soil conservation measures and topography of the watersheds.

The Kodiakanal hills, a spur of the Western Ghats has a total area of one lakh hectares of which one-fifth area is under cultivation. The forests including unique natural *shola* forests constitute 60 per cent of the geographical landscape. The resource management studies in this hill have not been attempted fully. The soil erosion is a menace due to large scale clearing of forest for habitation and plantation in recent years. An estimated amount of 0.5 cm of surface soil layer has been lost every year. To have an understanding of the magnitude of the problem, soil conservation, vegetation, rainfall and stream flow were to be studied in a comprehensive manner. Keeping these in view, an attempt was made in this investigation to study the combined effect of rainfall, stream flow and vegetation on soil erosion, run off and nutrient loss.

MATERIALS AND METHODS

The investigation was conducted during June, 1991 to May, 1992 in banana cultivated watershed at Perumalmalai and a forest *shola* watershed in Gundar reserve forest Kodaikanal. These two watersheds were covered by different vegetations, Perumalmalai watershed being devoted to banana cultivation and having contour stone wall as soil conservation measure and the forest *shola* watershed having trees, shrubs and grasses without any soil conservation measure. The Perumamalai watershed was located at 1500 m above MSL while *shola* watershed was at 200 m above MSL. The basic soil properties of the surface soils of the watersheds were analysed (Jackson, 1973) and presented in Table 1. The run off water was measured by using 'V' notch fixed at the end point of the watershed. Soil loss was measured by collecting the eroded soil sediments in a pit, 1 m^3 in dimension. The pit was dug at the lower most point of the watershed, just 10 m above 'V' notch and the pits were lined with polyethylene sheets (Wischmeier and Smith, 1978). The sediment collected was quantified by weighing the deposited soil. The sediment loss and the run off loss were monitored continuously from June, 1991 to May 1992. The nutrient losses were assessed by analysing the run off water (AOAC, 1980) for their nutrient contents and further multiplying them with the quantum of run off water.

RESULTS AND DISCUSSION

The data collected on rainfall, sediments, run off water and nutrient loss are presented in Table 2, 3 and 4. A cumulative rainfall of 1215.6 mm in 45 rainy days was recorded in *shola* watershed while it was 1196.6 mm in 43 rainy days in the banana watershed (Table 2). These two recorded quantities of rainfall were on a par as indicated by paired 't', test analysis. In the month of October, the rainfall recorded was high (326.5 and 295.0 mm for *shola* and banana watersheds, respectively). The number

Table 1. Initial soil sample analyses of *shola* and banana watersheds

Particulars	Watersheds	
	Shola	Banana cultivated
Mechanical analysis		
Clay	32.83	18.97
Silt (%)	11.87	11.65
Fine sand (%)	29.91	31.51
Coarse sand (%)	25.39	37.77
Physical constants		
Apparent specific gravity (g cm^{-3})	1.01	1.07
True specific gravity (g cm^{-3})	1.69	1.71
Volume expansion (%)	5.69	3.33
Pore space (%)	51.32	43.15
Maximum WHC (%)	50.99	39.14
Air dry moisture (%)	4.73	3.20
Organic carbon	5.37	3.78
Cation exchange capacity (me/100 g)	11.90	10.33
Nutrient elements (kg/ha)		
Total N	3477.0	2467.0
Total P	3595.0	2562.0
Total K	1890.0	1262.0
Available N	543.0	316.0
Available P	18.0	14.0
Available K	182.0	140.0
Dithionite iron (%)	1.9	2.2
Aggregate stability co-efficient (%)	0.46	0.58

of effective rainy days was also more in October than in other months. Both the watersheds faced a dry spell during February and March. The monthly rainfall averages of 109.3 and 99.7 mm, respectively for *shola* and banana water sheds were recorded.

As a consequence of the high rainfall intensity during the month of October, the highest quantities of sediments were also recorded. The sediment losses due to soil erosion were found to be low during January. The data on sediment loss indicated that *shola* watershed with slopping topography recorded higher quantum of soil erosion than the banana cultivated watershed protected by contour stone wall. On an average, 50 kg of top soil had been eroded from the *shola*, while it was only 42 kg in banana watershed. The probable reason that could be attributed to this observed phenomenon could be ascertained from the initial soil analysis (Table 1). The *shola* soil contained a higher amount of clay (32.83%) than the banana grown soil which had only 18.97 per cent clay. The aggregate stability coefficient showed that soils of banana watershed were more stable (0.58%) than *shola* soils. Further, dithionite iron which contributed sufficiently for soil aggregation was more in banana watershed (2.2%) than in the *shola* watershed. These factors have evidently contributed to the enhanced losses of sediments from the *shola* watershed. These observations are in agreement with the reported results of Langdale *et al.*, (1986).

As observed in the quantification of eroded sediments, the run off water (Table 3) was also

Table 2. Rainfall pattern in *shola* and banana watersheds.

Month/year	*Shola* watershed			Banana watershed		
	Rainy days		Rainfall (mm)	Rainy days		Rainfall (mm)
	Total	Effective		Total	Effective	
Jun '91	13	3	140.0	11	3	112.5
July '91	7	4	64.0	8	5	85.0
Aug '91	9	1	72.1	7	2	62.4
Sep '91	12	7	136.8	10	5	120.5
Oct '91	21	12	326.5	20	10	295.0
Nov '91	10	4	154.0	10	4	152.4
Dec '91	6	2	43.0	11	4	70.5
Jan '92	2	1	12.0	4	2	62.0
Feb '92	-	-	-	-	-	-
Mar '92	-	-	-	-	-	-
Apr '92	11	5	62.7	9	4	75.5
May '92	15	6	184.5	12	4	160.8
Total	106	45	1215.6	102	43	1196.6

Table 3. Sediment and run off loss in *shola* and banana watersheds

Month/ year	*Shola* watershed		Banana watershed	
	Sediment (kg/ha)	Run off water (kg/ha)	Sediment (kg/ha)	Run off water (kg/ha)
Jun '91	56.25	1,44,006	35.00	91,250
Jul '91	25.64	80,230	21.52	60,525
Aug '91	36.15	1,00,815	28.55	80,830
Sep '91	82.15	1,27,360	81.44	1,03,980
Oct '91	195.90	2,64,300	137.55	1,58,705
Nov '91	76.20	1,30,500	76.20	1,28,715
Dec '91	21.53	57,525	22.17	43,250
Jan '92	4.80	14,400	16.00	59,500
Feb '92	-	-	-	-
Mar '92	-	-	-	-
Apr '92	24.75	1,08,270	27.75	50,845
May '92	73.80	1,82,450	80.50	1,32,300
Total	597.14	12,07,856	526.68	9,09,900
Mean	49.76	1,00,655	43.89	72,825
SD	54.68	78,366	41.28	5,00,087

found to be higher (12,07,856 l/ha) in *shola* watershed than the banana watershed (9,09,900 l/ha). The monthly averages were to the tune of 1,00,655 l/ha and 72,825 l/ha, respectively for *shola* and banana watersheds. The above values were found to be higher during October, which crresponded to the pattern of rainfall recorded. The amount of run off water collected from both *shola* and banana watershed had no significant difference as indicated by paired 't' test. The test difference was marginalised by the presence of soil conservation measure and banana leaf mulch in the banana watershed and by the dense vegetation and leaf fall in *shola* watershed.

The dissolved N loss through run off water (Table 4) was higher in the *shola* watershed (7.36 kg/ha/month) than in the banana watershed (6.46 kg/ha/month) while the P loss ranged from 0.05 to 1.15 kg/ha. As in N and P, the K lost through run off water was also higher (5.44 kg/ha/month) under *shola* system than in the banana (4.32 kg/ha/month) watershed. The N and K losses through run off water was considerable, but the magnitude of N loss was higher than K in both the watersheds. Under slopy hill terrian, these two nutrients were prone to easy leaching and further the dominance of kaolinitic clay could have favoured the easy leaching of monovalent cations. The low amount of P loss was attributed to its limited solubility under acidic laterite. The higher amount of nutrients lost through run off under *shola* ecosystem could be a reflection of the magnitude of run off water, steap surface topography and the absence of soil conservation measures. In addition, their differential initial nutrient content (Table 1) could have also contributed to the difference. Earlier, Kannan (1990) also arrived at this conclusion in his work relating to Kodaikanal situations.

Table 4. Major nutrient loss in *shola* and banana watersheds

Month /year	*Shola* watershed			Banana watershed		
	(Dissolved nutrients, kg in total run off water)					
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Jun '91	7.00	0.245	5.26	5.07	0.179	3.85
Jul '91	4.32	0.140	2.32	3.25	0.125	1.85
Aug '91	5.41	0.190	3.85	3.76	0.146	1.75
Sep '91	12.29	0.490	9.75	11.56	0.429	8.54
Oct '91	28.34	1.150	18.35	27.00	1.030	15.25
Nov '91	12.85	0.541	10.64	10.65	0.468	8.65
Dec '91	4.38	0.132	3.28	3.76	0.145	1.85
Jan '92	1.29	0.050	2.50	1.50	0.050	1.50
Feb '92	-	-	-	-	-	-
Mar '92	-	-	-	-	-	-
Apr '92	4.22	0.145	3.12	3.75	0.120	2.50
May '92	8.30	0.425	6.25	6.95	0.268	5.25
Total	88.40	3.508	65.32	77.51	0.978	50.79
Mean	7.36	0.292	5.44	6.46	0.248	4.23
SD	7.82	0.326	5.25	7.42	0.288	4.52

The study, though by no means conclusive at this stage, confirm certain observed phenomena in Kodaikanal ecosystem. The *shola* cover is the natural source of protection to the rolling hills. The banana plantation, even though protected by contour walls, suffered loss due to surface run off both in terms of top soil and nutrient loss. But certain amount of cultivation for sustenance of population is to be encouraged and the crops so grown have a place in the mountain economy. But in any thoughtful scheme of cultivation, soil conservation in terms of vegetational cover will have to be emphasised.

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EFFECT OF SOIL TEST METHODS ON POD YIELD, RESPONSE AND UPTAKE OF NUTRIENTS IN GROUNDNUT

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ABSTRACT

A study was conducted at Chinnathadagam, Coimbatore during the year 1987-88 with three levels of nitrogen (0,20 and 40 kg ha^{-1}), four levels of phosphorus (0, 20, 40 and 60 kg ha^{-1}), five levels of potassium (0, 30, 60, 90 and 120 kg ha^{-1}) and three levels of farm compost (0, 6 and 12 t ha^{-1}) to find out the influence of soil test methods on pod yield, response and uptake of nitrogen, phosphorus and potassium in groundnut Co.1. Significant positive correlations were obtained between the soil test methods and the pod yield of groundnut. However, with uptake the $KMnO_4$ - N had a negative relationship evidencing that significant contribution of N is from the native source.

Soil testing is well recognised as one of the scientific means for quick characterisation of the fertility status of the soils and predicting the nutrient requirement of crops. The economic and judicious use of fertilisers is based on soil tests. Hence the present investigation was carried out to evaluate the soil test methods and their influence on pod yield, response and uptake of nutrients in groundnut.

MATERIALS AND METHODS

The experiment was conducted on loamy sand soil (Udic Haplustalf). The soil had a pH of 7.4 and organic matter content of 0.49 per cent. It was low, medium and medium with respect to available nitrogen, available phosphorus and available potassium status (196, 148 and 264.2 kg ha^{-1}) respectively. The treatments consisted of 3 levels of nitrogen (0, 20 and 40 kg ha^{-1}), 4 levels of phosphorus (0, 20, 40 and 60 kg ha^{-1}), 5 levels of potassium (0, 30, 60, 90 and 120kg ha^{-1}) and 3 levels of farm compost (0, 6 and 12 t ha^{-1}). Twenty selected combinations of NPK with farm compost and four control were distributed over each of the four gradient strips in a factorial randomised block design. The soil samples were analysed for $KMnO_4$-N (Subbiah and Asija, 1956) Olsen - P (Olsen *et al.*, 1954) and NH_4OAc-K (Hanway and Heidal, 1952). The plant samples were collected at post harvest stage and analysed for the different nutrients following the standard analytical procedures then the respective uptake was calculated (Jackson, 1973).

Plant uptake (kg ha^{-1})

$$\frac{\text{Per cent nutrient in pod}}{100} \times \text{Pod yield (kg ha}^{-1}) + \frac{\text{Per cent nutrient in haulm}}{100} \times \text{Haulm yield (kg ha}^{-1})$$